CLAIMS

We claim:

1. A method for laser deposition comprising the steps of:

providing one or more sources of laser energy that produce laser energy;

providing a receiving substrate;

wherein the receiving substrate is positioned opposite the source of laser energy;

providing a target substrate;

wherein the target substrate is positioned between the receiving substrate and the source of laser energy;

wherein the target substrate comprises a laser-transparent support and a composite material;

wherein the laser-transparent support has a laser-facing surface facing the source of laser energy;

wherein the laser-transparent support has a support surface facing the receiving substrate;

wherein the composite material has a back surface in contact with the support surface;

wherein the composite material has a front surface facing the receiving substrate;

wherein the composite material comprises a comprises a matrix material and a transfer material; and

wherein the matrix material has the property of being desorbed from the laser-transparent support when exposed to the laser energy;

positioning the source of laser energy in a spaced relation to the target substrate so that the laser energy will strike the composite material at a defined target location;

positioning the receiving substrate in a spaced relation to the target substrate; and

exposing the target substrate to the laser energy;

wherein the laser energy is directed through the laser-facing surface and through the laser-transparent support to strike the composite material at the support surface-back surface interface at the defined target location;

wherein the laser energy has sufficient energy to cause the desorption of the composite material from the support surface; and

wherein the desorbed composite material is deposited at a defined receiving location on the receiving substrate to form a deposited composite material.

2. The method of claim 1,

wherein the method is controlled by a computer.

3. The method of claim 1,

wherein the steps are carried out at about room temperature; and

wherein the steps are carried out at about atmospheric pressure.

4. The method of claim 1,

wherein the steps are carried out under one or more controlled conditions selected from the group consisting of humidity, atmospheric composition, air pressure, temperature, sterility.

5. The method of claim 1,

wherein the source of laser energy is a pulsed laser.

6. The method of claim 1,

wherein the laser energy is focussed through an objective.

7. The method of claim 1,

wherein the steps of positioning the source of laser energy and positioning the receiving substrate are achieved through the use of one or more

positioning means selected from the group consisting of a laser positioning means, a target substrate positioning means, and a receiving substrate positioning means.

8. The method of claim 1,

wherein the steps of positioning the source of laser energy, positioning the receiving substrate, and exposing the target substrate are repeated at successive defined target locations and successive defined receiving locations; and

wherein the composite material is deposited in a two-dimensional pattern or a three-dimensional pattern of deposited composite material.

9. The method of claim 1 comprising the following additional steps performed before the step of providing a target substrate:

positioning the receiving substrate in a spaced relation to the source of laser energy; and

exposing the receiving substrate to the laser energy so that the laser energy machines away a defined machining location on the receiving substrate.

10. The method of claim 9,

wherein the defined machining location comprises a via through the receiving substrate.

11. The method of claim 9,

wherein the composite material is deposited into a defined machining location that has been previously machined away by the laser energy.

12. The method of claim 1 comprising the following additional steps after the step of exposing the target substrate:

removing the target substrate from its position between the source of laser energy and the receiving substrate;

positioning the receiving substrate in a spaced relation to the source of laser energy; and

exposing the receiving substrate to the laser energy so that the laser energy machines away a defined machining location on the receiving substrate or on the deposited composite material.

13. The method of claim 12,

wherein the defined machining location comprises a via through the receiving substrate.

14. The method of claim 1,

wherein the step of providing a target substrate is repeated one or more times using target substrates comprising different composite materials; and

wherein the different composite materials are deposited in respective patterns on the receiving substrate.

15. The method of claim 14,

wherein the different composite materials comprise different transfer materials.

16. The method of claim 14,

wherein one or more composite materials comprise a matrix material and an electronic transfer material; and

wherein one or more electronic transfer materials are used to create electronic circuitry on the receiving substrate.

17. The method of claim 16,

wherein the one or more electronic transfer materials are independently selected from the group consisting of metal, dielectric, resist, semiconductor, and combinations thereof.

18. The method of claim 1,

wherein the laser-transparent support comprises quartz or machine etched quartz.

19. The method of claim 1,

wherein the laser-transparent support comprises a laser-transparent flexible polymer ribbon.

20. The method of claim 1,

wherein the support surface of the laser-transparent support comprises a laser-absorbing layer in contact with the back surface of the composite material; and

wherein the laser-absorbing layer is vaporized by the laser energy.

21. The method of claim 20,

wherein the laser-absorbing layer comprises one or more materials selected from the group consisting of gold, chrome, and titanium.

22. The method of claim 1,

wherein the receiving substrate comprises a non-planar surface.

23. The method of claim 1,

wherein the receiving substrate comprises one or more materials selected from the group consisting of chemically functionalized glass, polymer-coated glass, quartz, natural hydrogel, synthetic hydrogel, uncoated glass, nitrocellulose coated glass, silicon, glass, plastics, metals, and ceramics.

24. The method of claim 1,

wherein the receiving substrate comprises functionalization selected from the group consisting of covalent functionalization, physisorbed functionalization, and combinations thereof.

25. The method of claim 24,

wherein the functionalization is selected from the group consisting of a living host, a living cell, a living cell culture, a non-living cell, a non-living group of cells, a living tissue, a chemically functionalized surface, and a biologically functionalized surface.

26. The method of claim 1,

wherein the transfer material comprises a biomaterial.

27. The method of claim 26,

wherein the biomaterial is living or active.

28. The method of claim 27,

wherein the living or active biomaterial remains living or active on the receiving substrate.

29. The method of claim 26,

wherein the biomaterial comprises one or more materials selected from the group consisting of proteins, hormones, enzymes, antibodies, DNA, portions of DNA strands, inorganic nutrients, aqueous salt solutions, RNA, nucleic acids, aptamers, antigens, lipids, oligopeptides, polypeptides, cofactors, and polysaccharides.

30. The method of claim 26,

wherein the biomaterial comprises one or more materials selected from the group consisting of a single cell, groups of cells, living cells, multi-cell assemblies, pluripotent cells, stem cells, heart cells, lung cells, muscle cells neurons, and neural networks.

31. The method of claim 26,

wherein the biomaterial comprises one or more materials selected from the group consisting of living tissue, skin, hair-producing tissue, nail-producing tissue, and brain tissue.

32. The method of claim 26,

wherein the biomaterial comprises one or more materials selected from the group consisting of DNA-coated particles, protein-coated particles, and RNA-coated particles.

33. The method of claim 26,

wherein the biomaterial comprises one or more functional supporting media selected from the group consisting of nutrients, and other life supporting material.

34. The method of claim 26,

wherein the biomaterial comprises one or more tagging compounds selected from the group consisting of organic tagging compounds and inorganic tagging compounds.

35. The method of claim 26,

wherein the composite material is at about the incubation temperature of the biomaterial.

36. The method of claim 1,

wherein the matrix material comprises one more materials selected from the group consisting of glycerol, water, polymer, cell medium, cell nutrient, natural hydrogel, synthetic hydrogel, surfactant, antibiotic, antibody, antigen, protein, dimethylsulfoxide, water/dimethylsulfoxide mixture, agarose, saline solution, dielectric particles, metal particles, aqueous inorganic salt solution, nitrocellulose gel, sol gel, ceramic composite, DNA-coated particles, protein-coated particles, and RNA-coated particles.

37. The method of claim 1,

wherein the matrix material comprises a mixture of water and glycerol.

38. The method of claim 1,

wherein the composite material is frozen to the laser-transparent support.

39. The method of claim 1,

wherein the composite material is at a temperature of from about -50°C to about 100°C.

40. The method of claim 1,

wherein the deposited composite material is an engineered cellular or composite structures for growth, repair, replacement, or improvement of tissue.

41. The method of claim 1,

wherein the deposited composite material is a living organ.

42. The method of claim 1,

wherein the deposited composite material is a device to investigate inter- and intracellular signaling.

43. The method of claim 1,

wherein the deposited composite material is a living device to control or divert the flow of fluid through microfluidic channels.

44. The method of claim 1,

wherein the deposited composite material is a living, miniature electrode.

45. The method of claim 1,

wherein the deposited composite material is a neural network.

46. The method of claim 1,

wherein the deposited composite material is a device to investigate cell aging.

47. The method of claim 1,

wherein the deposited composite material is a bridge to connect a nerve synapse.

48. The method of claim 1,

wherein the deposited composite material is a biofilm.

49. The method of claim 1,

wherein the deposited composite material is a drug delivery system or coating.

50. The method of claim 1,

wherein the deposited composite material is an implantable drug delivery system.

51. The method of claim 1,

wherein the deposited composite material is a chemical or biological sensing device to sense chemicals or biomaterials.

52. The method of claim 1,

wherein the deposited composite material is an implantable, biocompatible sensor/signaler device.